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ABSTRACT

To gain statistical information as to the success of the Developmental Mathematics course (Math 01) at Danville Community College, data were collected on 77 students who completed the course between the winter quarter 1970-71 and the fall quarter 1971-72. The grades of this group in six subsequent mathematics courses were compared with those of students who did not take Math 01. The results of the study, which are tabulated, showed that Math 01 was not entirely successful in preparing students for two subsequent courses, but students were well prepared to enter four courses in that they had better than a "C" average in each of the four. The students who had taken Math 01 also made better grades than the group who had not in three of the subsequent courses. (An appendix provides topic descriptions of the content of each of the math courses.) (DB)

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DANVILLE COMMUNITY COLLEGE

DANVILLE, VIRGINIA

A STUDY OF THE EFFECTIVENESS OF THE DEVELOPMENTAL MATHEMATICS COURSES AT DANVILLE COMMUNITY COLLEGE

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TABLE OF CONTENTS

Section		Page
I.	INTRODUCTION	1
II.	BACKGROUND AND DESCRIPTION	1
III.	METHODS	4
IV.	RESULTS	4
V.	ANALYSIS AND CONCLUSIONS	9
	BIBLIOGRAPHY	12
	APPENDIX	13
	Appendix A: Topic-Descriptions	13

LIST OF TABLES

Table		Page
1.	Number and Percentage of Grades of A, B, C, D, and F for 118 Grades for Group 1 and 1,047 Grades for Group 2	6
2.	Percentages and Cumulative Percentages of Grades of A, B, and C	7
3.	Math Grade Point Average	8
4.	Distribution of Students in Group 1	9

INTRODUCTION

This study which is the first of a series was conducted in order to gain statistical information as to the success of the Developmental Mathematics (Math 01) at Danville Community College (DCC). It was felt that measuring the success of students who completed Math 01 would be one means of measuring the success of the developmental math courses. Further, it was hoped that the students who completed Math 01 were as successful in their credit math courses as those students who did not take Math 01.

Background and Description

> During the last decade, . . . a major revolution has taken place in Virginia's education at the post high school level. The birth of the Community College system has consolidated the community divisions of the universities and the local technical schools into one system that in philosophy and support rightfully deserves the title 'Community College' . . . . [3:1]

Since the community college has an "open-door" admission policy, any high school graduate or any adult regardless of his previous educational background may be admitted. As a result of this policy, some students who enter a community college are not mathematically prepared to enter their desired curriculums. Therefore, a developmental mathematics course (non-college credit) was established. This course was designed to help the individual develop the basic skills and understanding necessary to succeed in a program of the college. The availability of a developmental math course makes the "open-door" a reality for many of the potential students in that this course provides the opportunity for an open door to success rather than failure.

A student who is deficient in mathematics but otherwise qualified for his chosen curriculum can usually remove this deficiency in one to three quarters in the developmental math course. If a student completes the predetermined requirements in developmental math within a specified length of time, he will usually be successful in his college credit math course.

The developmental mathematics courses on which this study was conducted are structured as described in Moore and Griffin [3]. This type structure is described briefly in the following quotes:

> 3. Departmentalized Developmental Studies. This is a developmental study within a department . . . . For example, the developmental math would be within the mathematics department and taught by the math instructors. [3:7]

> . . . at DCC we are preparing students for five different levels of mathematics. . . . we offer basic math, algebra one, algebra two (two different levels), and trigonometry. [3:9]

Math 01 is highly individualized and uses programmed textbooks. (The books used are: Computational Arithmetic by Pappin; Algebra I Programmed: Books 1 and 2 by Alwin and Hackworth; Algebra II Programmed: Books 3 and 4 by Alwin, Hackworth, and Howland; Algebra 2 Temac Programmed by Titiev; and Trigonometry Temac Programmed by Luckham). Math 01 meets five 50-minute periods per week for 5 credit hours per quarter. Each class contains an average of 15-20 students, one instructor, and a work-study student. While the work-study student distributes and collects tests, the instructor is free to give individual help or to discuss test results with students.

It was voiced by most staff members at DCC that the individualized instruction helped students to develop abilities and attitudes which would be of benefit in other courses. This study was not designed to test such a hypothesis. However, according to Oen and Sweany "the individualized method was also significantly more successful

in developing student ability to locate and interpret information contained in turfgrass references." [4:26]

There are several approaches for teaching developmental studies. Bittinger [1] gives some pros and cons of six such approaches. He concludes that "in the final analysis applicability may depend on students, instructors, and schools." [1:458]

Bloomberg [2] compared the traditional approach to an individualized approach to teaching Basic Mathematics Review (BMR) at Essex Community College in Maryland. He drew several conclusions one of which was that "students succeeding in the individualized BMR achieved significantly higher in credit mathematics courses than students not required to take BMR." [2:7]

This study compares the success of students who completed Math 01 with that of those who did not take Math 01. The Math 11, 114, 151, 141, 161, and 181 sequences were used for this study to make this comparison. The Math 11 sequence is designed for automotive mechanics, printing, and machine shop students and contains topics from arithmetic and elementary algebra and trigonometry. These topics are applied to each curriculum. The Math 114 sequence which is designed for drafting and design students contains topics from algebra, trigonometry, and calculus. The Math 151 sequence is taught to the business management students. It contains topics from arithmetic and elementary algebra applied to this curriculum. The Math 141 sequence is a rigorous calculus course for pre-engineering and pre-mathematics students. The Math 161 sequence is designed for business administration, liberal arts, and some science students. It contains algebra, trigonometry, probability, and differential calculus. The Math 181 sequence for pre-teacher and liberal arts students contains topics from algebra, set theory, logic, probability, and statistics. For a complete topic description of each course, see Appendix A.

Methods

This study contains information about 77 students who completed Math 01 between the Winter Quarter of the 1970-71 academic year and the Fall Quarter of the 1971-72 academic year (the 1971 calendar year). This group will be identified as Group 1. The grades for the Math 11, 114, 151, 141, 161, and 181 sequences during the 1971-72 academic year were used in this study. Those students who did not take Math 01 form Group 2. Since all students had not completed a credit math sequence at the time this study was conducted, the number of letter grades (quarter grades) was used instead of the number of students except in Table 4.

It was felt that measuring the success of Group 1 would be one means of measuring the success of the developmental math courses. This was done in three ways. First, the percentages of grade of A, B, C, D, and F for students in Group 1 were compared with those for students in Group 2 (see Tables 1 and 2). Second, a comparison between the math grade point average (GPA) for Group 1 and the GPA for Group 2 was made. This was done individually for each of the six math sequences (see Table 3). Finally, the students of Group 1 were divided according to the number of quarters spent in Math 01. These were placed into one of four subgroups: (1) those who completed their credit math sequence, (2) those who were not required to take one of the six math sequences mentioned above, (3) those who did not return to college or who withdrew from college before completing their credit math, and (4) those who were in school and had not completed their credit math when this study was conducted. (See Table 4).

Results

Table 1 shows the number and percentages of grades of A, B, C, D, and F for each of the six math sequences for Group 1 and Group 2.

It should be pointed out that these figures are not from a random sample. The 188 and 1,047 grades for Group 1 and Group 2, respectively, represent all students who took one or more quarters of one or more of the six math sequences between Fall, 1971, and Summer, 1972.

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TABLE 1. NUMBER AND PERCENTAGE OF GRADES OF A, B, C, D, AND F FOR 118 GRADES FOR GROUP 1 AND 1,047 GRADES FOR GROUP 2

Math Series		A		B		C		D		F		Total	
		G1*	G2**	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2
11	#	0	23	4	28	4	33	5	25	1	10	14	117
	%	0.0	19.7	28.6	23.9	28.6	28.2	35.7	19.7	7.1	8.6		
114	#	0	16	2	24	4	23	0	22	0	13	6	98
	%	0.0	16.3	33.3	24.5	66.7	23.5	0.0	22.5	0.0	13.3		
151	#	2	43	9	51	9	54	7	39	3	45	30	232
	%	6.7	18.5	30.0	22.0	30.0	33.3	23.3	16.8	10.0	19.4		
141	#	0	17	1	12	3	10	1	2	1	3	6	44
	%	0.0	38.6	16.7	27.3	50.0	22.7	16.7	4.6	16.7	6.8		
161	#	4	28	4	28	9	56	2	41	3	46	22	219
	%	18.2	12.8	18.2	21.9	40.9	25.6	9.1	18.7	13.6	21.0		
181	#	3	28	16	79	10	111	6	64	5	55	40	337
	%	7.5	8.3	40.0	23.4	25.0	32.9	15.0	19.0	12.5	16.3		

* G1 - Students completing developmental mathematics

** G2 - Students not required developmental mathematics

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Table 2 shows the percentages and the cumulative percentages of grades of A, B, and C for Groups 1 and 2 in each of the six credit math sequences.

TABLE 2. PERCENTAGES AND CUMULATIVE PERCENTAGES OF GRADES OF A, B, AND C

Math Series	Group*	A	B		C	
		%	%	cum%	%	cum%
11	1	0.0	28.6	28.6	28.6	57.2
	2	19.7	23.9	43.6	28.2	71.8
114	1	0.0	33.3	33.3	66.7	100.0
	2	16.3	24.5	40.8	23.5	64.3
151	1	6.7	30.0	36.7	30.0	66.7
	2	18.5	22.0	40.5	33.3	73.8
141	1	0.0	16.7	16.7	50.0	66.7
	2	38.6	27.3	65.9	22.7	88.6
161	1	18.2	18.2	36.4	40.9	77.3
	2	12.8	21.9	34.7	25.6	60.3
181	1	7.5	40.0	47.5	25.0	72.5
	2	8.3	23.4	31.7	32.9	64.6

*Group 1 represents students who completed developmental mathematics.
Group 2 represents students not required to take developmental mathematics.

It should be pointed out that in the Math 161 and 181 sequences the cumulative percentage in the "B" column was higher for Group 1 than Group 2. Furthermore, in the Math 114 sequence Group 1 had a much higher cumulative percentage in the "C" column than did Group 2. It should be noted that in the Math 114 sequence Group 1 had accumulated 100% with grades of A, B, and C. However, the sample size may not be considered significant because only six students from Group 1 (5.8% of the Math 114 sequence enrollment) took the Math 114 sequence.

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Table 3 shows the math grade point average (GPA) in each of the six math sequences for Groups 1 and 2 and for the total group. These GPA's were calculated using the upper figures in Table 1 and are based on a 4.000 scale. The "% of Total" column indicates the percentage of the total group contained in Group 1.

TABLE 3. MATH GRADE POINT AVERAGE COMPARISON*

Math Series	% of Total	Group 1	Group 2	Total Group
11	10.7	1.786	2.479	2.389
114	5.8	2.333	2.245	2.250
151	11.5	2.067	2.220	2.202
141	12.0	1.667	3.250	3.060
161	9.1	2.364	1.995	2.029
181	10.6	2.225	1.967	1.995

*Based on a 4.000 scale

In the Math 11 and 141 sequences, Group 2 had a higher overall GPA than Group 1. Group 2 averaged a "C" and a "B" in Math 11 and 141, respectively, as opposed to a "D" average for Group 1 in both sequences. Table 3 also shows Group 1 with a higher GPA in Math 114 and a lower GPA in Math 151 than that of Group 2. But, Group 1 earned an average grade of "C" as opposed to an average grade of "D" for Group 2 in the Math 161 and 181 sequences.

Table 4 shows the number of students who took Math 01 for an indicated number of quarters. In addition, Table 4 is subdivided into four subgroups: (1) students who completed their credit math sequence, (2) students who were not required to take one of the six math sequences, (3) students who did not return to college or who withdrew before completing their math sequence, and (4) students who were in college and had not completed their credit math sequence when this study was conducted.

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TABLE 4. DISTRIBUTION OF STUDENTS IN GROUP 1

# of Quarters	# of Students	(1) Completed Credit Math	(2) Not Required Credit Math	(3) Dropped Out	(4) In School But Not Completed
1	35	16	2	9	8
2	29	10	6	8	5
3	6	2	2	0	2
4	6	3	0	2	1
5	1	0	0	1	0
Total	77	31	10	20	16
% of Total		40.3	13.0	26.0	20.7

NOTES:

(2). These students were not required to take either the Math 11, 114, 151, 141, 161, or 181 sequence.

(3). These students were not enrolled at DCC when this study was conducted.

It should be pointed out in Table 4 that better than 40% of Group 1 completed their credit math during a four quarter period.

Analysis and Conclusions

Table 2 seems to indicate that students who completed developmental math were not as well prepared to enter the Math 11 and 141 sequences as those entering another math sequence. However, it was felt that a course in basic math would help to better prepare students for the Math 11 sequence. (See Appendix A for topic-descriptions of Basic Math and Math 11.) Because the Math 11 sequence contained very little

algebra, the Math 01 which began with algebra was not what the students entering Math 11 needed. By beginning Math 01 with basic math, students preparing to enter Math 11 could study topics closely related to those to be studied in their credit math. It was felt that students entering the Math 141 sequence which begins with calculus needed a good background in theory and proofs which Math 01 did not give at the time of this study.

From Table 2 it can be seen that students from Group 1 have been more successful than those from Group 2 in the Math 114, 161, 181 sequences. The primary reason for the big success of Group 1 in the Math 114, 161, 181 sequences probably was the closeness of the two sequences to the Math 01 courses in terms of the topics covered, the presentation of the material, and the level of difficulty of the material. To see the closeness of the topics covered, compare those listed in Appendix A under Math 01, Books 1, 2, 3, and 4; Math 181-182-183; Math 161-162-163; and Math 114-115-170.

Table 3 shows that Group 1 did better than Group 2 in the Math 114, 161, and 181 sequences. Group 2 did better than Group 1 in the Math 11, 151, and 141 sequences, although Group 1 maintained a "C" average in the Math 151 sequence. This indicates success for Group 1 in the Math 151 sequence. Partially as a result of this study, we have incorporated a Basic Math course into the Math 01 courses. Thus in the future, Math 01 should better prepare students to enter the Math 11 sequence or the Math 151 sequence.

The figures in Table 4 indicate that over 40% of the students from Group 1 completed their credit math during a four quarter period. Five of the ten who were not required to take one of the six credit math sequences were not required to take any credit math. By adding this 6.5% to the percent above, it can be seen that almost 47% of Group 1 completed all credit math requirements during a four quarter period.

For various reasons 26% of Group 1 were not enrolled at DCC when this study was conducted. It should be pointed out that only one student was dismissed because of academic reasons. Most of these students had a GPA just below 2.000 their last quarter. Of the 20 students not at DCC, eleven did not return after the quarter in which they completed Math 01. Six of the remaining nine passed one or two quarters of their credit math before dropping out of college. The remaining three students failed one quarter of a credit math course before dropping out of college.

Table 4 shows that 16 students from Group 1 were enrolled at DCC at the time of this study but had not completed their credit math sequence. The success of these students should show up in a later study.

In conclusion, it was found that Math 01 was not entirely successful in preparing students for the Math 11 and 141 sequences. However, it was found that those students who completed Math 01 were well prepared to enter one of the Math 114, 151, 161, and 181 sequences in that Group 1 had better than a "C" average in each of these four sequences. It was also found that Group 1 made better grades than Group 2 in the Math 114, 161, and 181 sequences.

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APPENDIX A

Topic-Descriptions

Listed below are topic-descriptions of the content of each of the math courses discussed in this study:

MATH 01 - Basic Math

The Concept of Number
Addition and Multiplication of Natural Numbers
Subtraction and Division of Natural Numbers
Operations with Natural Numbers
Computations with Positive Rational Numbers
The Meaning and Use of Decimal Fractions
Ratio, Proportion, and Percentage
The Arithmetic of Measurement
The Square Root of Real Numbers
The Generalization of Arithmetic Processes
Work Problems

MATH 01 - Algebra (Books 1 and 2)

Sets
Counting Numbers
Integers
Rational Numbers
Equations Involving Two variables
Algebraic Polynomials, Factoring, and Fractions
Solving Fractional and Quadratic Equations
Quadratic Equations with Irrational Solutions

MATH 01 - Algebra II (Books 3 and 4)

System of Rational Numbers
System of Real Numbers
System of Complex Numbers
Sets, Relations, and Functions
Inequalities
Absolute Value
Graphing
Exponents
Factoring
Logarithms

MATH 01 - Algebra II (Temac)

Linear Equations
Special Products and Factoring
Fractions and Mixed Expressions
Cartesian Coordinates
Algebraic Methods--Solving Systems of Equations
Complex Numbers and Radicals
Functions and Variables
Logarithms
Quadratic Equations in Two Unknowns
Binomial Theorem
Progressions

MATH 01 - Trigonometry

Inequalities and Absolute Values
Rectangular Coordinate Systems: Graphs
Sets, Functions, and Graphs
Angles and Angular Measure
Special Triangles
Polar Coordinates
Sine Function
Cosine Function
Tangent Function
Reciprocal Functions
Solution of Right Triangles
Solution of Oblique Triangles
Fundamental Identities
Trigonometric Equations

MATH 11-12-13

Whole Numbers
Fractional Numbers
Decimal Numbers
Equations With Non-Negative Solutions
Systems of Measure
Measurement and Measuring Devices
Signed Numbers
Powers and Roots
Algebra With One Variable
Percents
Ratio and Proportion
Using and Manipulating Formulas
Perimeters, Areas, and Volumes
Graphs
Practical Trigonometry and the Right Triangle
Special Topics

MATH 114-115-170

Review of Arithmetic and Geometry
The Slide Rule
Applications in Geometry
Introduction to Algebra
Linear Equations in One Unkown
Functions and Graphs
Systems of Linear Equations
Exponents and Radicals
Quadratic Equations in One Unknown
Simultaneous Quadratic Equations
Ratio, Proportion, and Variation
The Binomial Theorem--Progressions
Logarithms
Graphical Methods of Calculus
Differentiation
Integration

MATH 151-152

Review of Operations
Review of Equations
Review of Per Cent
Basic Statistics and Graphs
Depreciation and Overhead
Financial Statement Analysis
Distribution of Profit and Loss
Taxes
Insurance
Checkbook Records
Wages and Payrolls
Commerical Discounts
Markup
Markdown and Turnover

MATH 141-142-143

Review of Number Systems
Sets and Set Operations
Solutions of Inequalities in Linear and Quadratic Form
Development of Cartesian Coordinate System
Analysis of Curves
Develop Distance Formula
Develop Formula for Circle
Translation of Coordinate Axes
Limits
Derivatives
Develop Formulas for Differentiation
Differentials

MATH 141-142-143 (Continued)

Tangents and Normals
Antiderivative
Fundamental Theorem of Calculus
Intermediate Value Theorem
Theorem of the Mean for Integrals
Simple Change of Variables
Trigonometric Limits
Logarithmic Function
Parametric Equations
Review Distance Formula
Integration by Substitution
Integration of Quadratic Functions
Review of Integration Techniques
Applications of the Integral
Center of Mass
Theorems of Pappus
Newton's Laws
Approximate Integration
Derivatives in Polar Coordinates
Three-space
The Sphere

MATH 161-162-163

The Number System
Sets
Natural Numbers and Positional Notation
Inequality and Absolute Values
Relations, Functions, and Graphs
Exponents, Radicals, and Algebra Review
More Relations, Functions, and Graphs
Equations of a Straight Line
Coordinate Systems and Graphing
Straight Line Slope
Conic Sections
Increments: Average Rates
Limits
Derivative
Differentiation of Algebraic Functions
Linear Motion
Maxima, Minima, and Inflection Points
Applications of Maxima and Minima
Implicit Differentiation
Related Rates
The Differential

MATH 181-182-183

Whole Numbers and Their Operations
Mathematical Structures
Developing the Integers
Developing the Rational Numbers
Equations and Inequalities
Polynomials
Irrational Numbers and Real Number Field
Relations and Functions
First Degree Equations and Inequalities
Quadratic Equations and Inequalities
Intuitive Geometry
Theory of Equations
Probability
Descriptive Statistics
Matrices
Linear Programming

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